Application of Computational M&S for ground vehicles at TARDEC

TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

Workshop on Advanced Computational Methods in Engineering and Environmental Sciences, CUNY, NY, 26-28 SEP 2011

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Concepts / Analysis / System Simulation / Integration (CASSI)

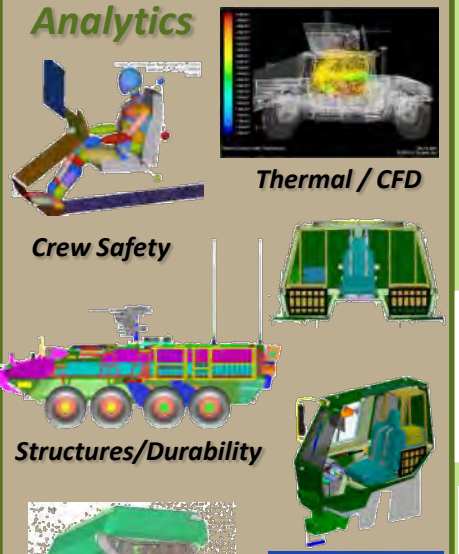
System-centric, M&S-based Services to integrate and assess the impacts of new concepts/technologies and changes to existing systems.

C

Advanced Concepts

A

Analytics



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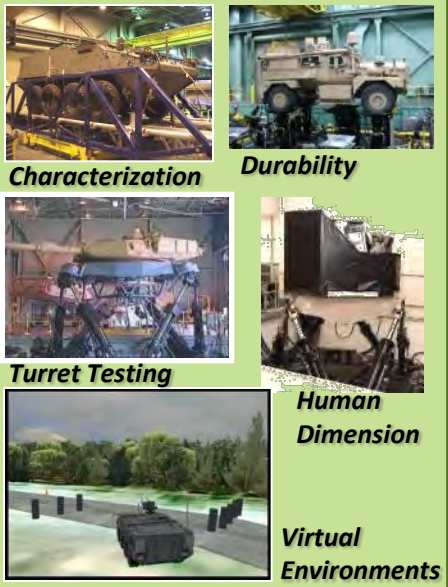
Hardware & Man-In-The-Loop Simulation



I

Integration & Demonstrators

HPC & Data Management

Key Partnerships with TARDEC Technology Groups, other Army RDECs/Labs, PM's, TRADOC – MCOE, TACOM Sys & Cost Analysis, ATEC, AEC

Mission & Objectives

- Mission:
  - Provide Rapid Assessment and Integration Services to both Technology and System/Platform Development Programs
    - Throughout the Platform Lifecycle
    - Consider Warfighter, System, and System-of-Systems (SoS) Contexts
- Objectives:
  - Provide Systems/SoS Perspective to Combat Developer, PM and Tech Developer on Requirements, Tradeoffs & Integration
  - Provide SWAP, Performance, Operational, Cost, & Sustainment Impacts
  - Provide and Share Configuration Managed Data on Technologies, Systems, M&S and related programs/processes
  - Explore Multiple Options and Trades Rapidly
- Methods:
  - Develop Vehicle Concepts & Perform Concept Analysis and Trade Studies
  - Perform System Assessments using Physics-based, Statistical-based, HW/Man-in-the-Loop, and Distributed Simulation Tools
  - Develop Integrated System Level Demonstrators

CASSI-Analytics Core Areas

Concepts, Integration & Analysis

- Vehicle / Tech Modeling
- Performance Analysis
- Vehicle/Tech Analysis
- Cost/ RAM Analysis
- Operational Analysis
- Vehicle / Technology Options

Performance Analysis

- Power Analysis
- Dynamics Analysis
- Automotive Performance Analysis
- Signature & Acoustic Analysis
- Blast Analysis
- Crew Safety Analysis
- Durability Analysis
- Weight Analysis
- Thermal (CFD) Analysis
- Optimization

- Reduce Time / Cost to Field
- Reduce Operations & Maintenance Costs (RAM)
- Improve Transportability
- Reduce Inventory
- Save Lives
- Reduce Injuries
- Reduce Failures
- Improve Fuel Economy
- Reduce Weight
- Reduce Risk

Evaluate Design Principles and Requirements

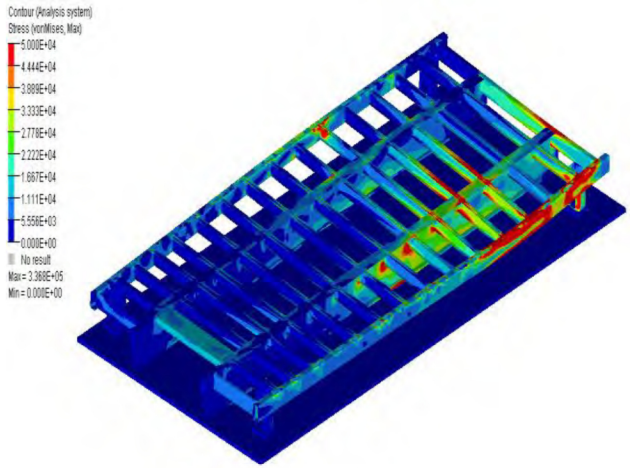
Good Systems Engineering

Computational Analysis Areas

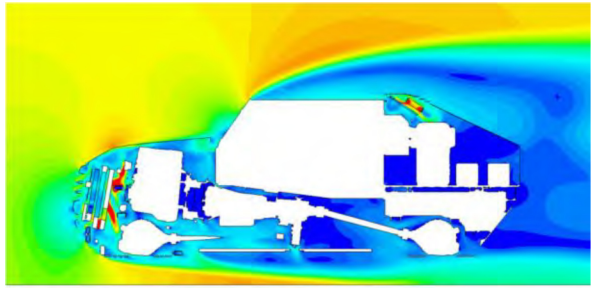
Multi-body Vehicle Dynamics
-Automotive Performance and Mobility Prediction

Crew Safety/ Biomechanics

Multi-body/FE - System Level Durability Degradation
-Wheeled and Tracked Vehicles



Finite Element Analysis
-Structural Integrity



CFD Analysis
-Thermal Mgmt

Non-Linear FE Impact Analysis - Blast Effects

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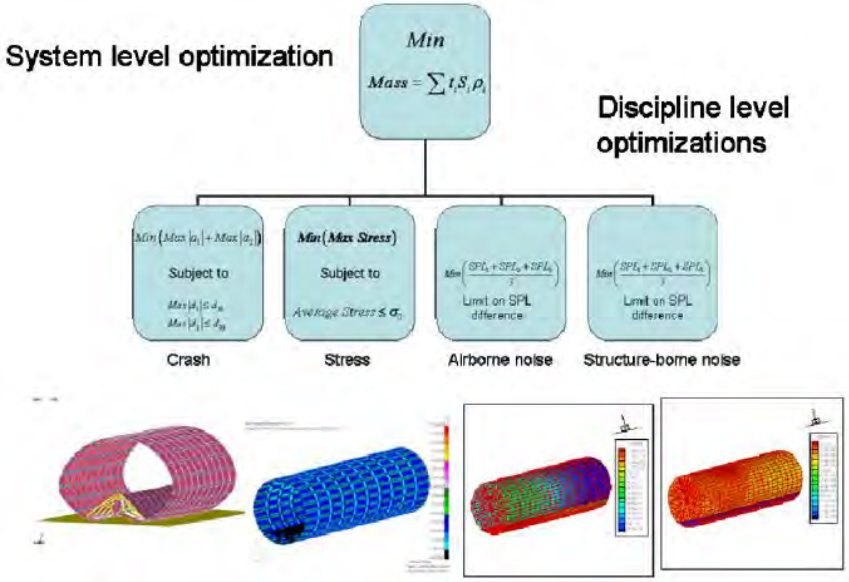
Multidisciplinary Design Optimization (MDO)

MDO software tool:

- Runs design optimization process for multiple analysis codes running in parallel
- Employs tailored metamodeling and optimization algorithms to concurrently meet:
  - System-level objectives (e.g., minimize vehicle weight)
  - Multiple discipline-level objectives (e.g., maximize durability and survivability)
- Shepherds discipline-level optimization processes to converge to a single solution
- Ensures that all constraints are satisfied by the final design



Example MDO process (Vlahopoulos et al., 2008)

Input:

- Model of initial design
- Design objectives and constraints
- Design parameters (can be shared across disciplines)
- Sufficient data to support M&S

Output:

- Metamodels from simulations
- Optimal system design

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Summary

- **Analytics is the Army's premier organization for providing fast, accurate System Level ground vehicle system M&S services**
- **In-house engineering analysts perform Soldier-centric vehicle assessments of new systems and modifications to existing systems**
- **Assessments advise customers on impacts to system-level performance and recommend improvements to Army and DoD vehicle designs**

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